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ABSTRACT

A study is being conducted to evaluate and revise an innovative science program which was field tested in three schools representative of urban, rural, and suburban populations. The objectives of the study are to assess the program's actual performance of its stated objectives and to inform the program developer of inherent strengths and weaknesses. A phase of the evaluation design is the examination of the Placement Tests. These were administered on a prepost basis for analysis. Results to date have been utilized in program revision and have provided evidence to support the need for formative evaluation of innovative instructional systems. (For related document, see TM 002 511.) (Author)

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A FORMATIVE EVALUATION OF INDIVIDUALIZED SCIENCE, AN INNOVATIVE INSTRUCTIONAL SYSTEM

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INTRODUCTION

No matter how effective an innovative instructional system may purport to be, its ultimate impact on education is determined by how appropriately and how widely it is implemented in the classroom, According to Tyler (1966), concurrent with the planning of an instructional system is the development of a means of assessing whether the system achieves its stated objectives. A critical evaluation of any instructional system is mandatory relative to the total developmental process. Such an evaluation will provide evidence concerning the appropriateness of the content and processes of the program.

In meeting the need for formative evaluation in curriculum development, Research for Better Schools of Philadelphia, Pennsylvania, is conducting an extensive evaluation of an innovative science curriculum throughout all levels of its development. The results of this formative evaluation serve as the basis for altering the nature of the program in its developmental stages.

The program, Individualized Science, is being developed at the Learning Research & Development Center at the University of Pittsburgh. The Imperial International Learning Corporation of Kankakee, Illinois, has contracted the commercial publication of the program. RBS plays the unique role of liaison with developers, publisher, and the field test and demonstration schools while

serving as the evaluator of the program. The Individualized Science program is basically a multi-media program directed toward the realization of a set of specific goals.

PURPOSE OF THE INVESTIGATION

It was the purpose of this paper to provide a brief description of the total formative evaluation effort extended by Research for Better Schools, Inc. relative to the innovative instructional system, Individualized Science. A more detailed description of one aspect of this evaluation effort has also been included in the paper. This involved a detailed analysis of the unit placement tests for the first two levels of the program.

DEFINITIONS

Formative Evaluation. Scriven (1967) defined formative evaluation as the evaluation of educational programs still in some stage of development. The product of such an evaluation effort is expected to be an improved instructional program.

INNOVATIVE INSTRUCTIONAL SYSTEM. Schutz (1968) refers to the effectiveness of instruction which is multiple mediated, individually paced, managed against objectives, and computer based. At the present stage of development, Individualized Science satisfies to some degree the listed criteria and has thus been defined as innovative.

CONCEPTUAL FRAMEWORK

In order to avoid a lengthy discussion concerning the rationale of the formative evaluation effort suffice it to say that every

attempt was made to adhere to the statement by Stake regarding formative evaluation, "To be fully understood, the educational program must be fully described and fully judged." Add to this philosophy the limiting factors imposed by the legal contractual arrangement among the three concerned parties, RBS, LRDC, and Imperial, and the following set of formative evaluation strategies emerged.

EVALUATION STRATEGIES

Through a consensus building process involving the developer, evaluator, and publisher the following procedures were determined and implemented in the collection of data. Formal reports describing the evaluation of each unit of the program were published and distributed to the developer and publisher on a scheduled basis. Following a review of the reports a meeting to be attended by representatives of the three parties is scheduled to determine the reasonableness of the evaluation findings for the final commercial edition of the program. A sample unit report appears as Appendix A. The data collection procedures are described in the following outline:

PREPARATION OF UNIT REPORTS

INDIVIDUALIZED SCIENCE

FORMATIVE EVALUATION

Data from the three field test schools are continually forwarded to RBS. These data include for each unit (1) all pupil planning sheets, (2) all pupil check-up lessons, and (3) all pupil placement tests (administered on a pre and post basis).

1. INITIAL ORGANIZATION - DATA ANALYSIS

   a. Planning sheets are reviewed for all pupils for the specific report to be completed;clerks compile the data into tables for review and reference.

   b. Placement tests administered on a pre-post basis are analyzed.

      (1) Individual lessons prescribed from both the pre and post placement test results are identified. Appropriate recommendations are suggested for those lessons which apparently are not achieving their stated objectives.

      (2) The paper and pencil and the audio cassette presentation of the test is scrutinized by an RBS Test and Measurement Specialist. Recommendations are delineated.

      (3) An item analysis is performed on each test. The results determine the reliability of the instrument and the difficulty of each item. Subsequent changes are recommended.

   c. Check-ups (built-in unit diagnostic instruments) are reviewed in order to provide evidence for incomplete learning experiences and/or poor test items.

   d. Problem sheets which contain comments and concerns are completed by teachers and reviewed, summarized, and interpreted as recommendations.

e. Teachers Manuals which include written comments and criticisms are collected from each teacher and reviewed. Comments are compiled and summarized.

f. Observation data from regularly scheduled school visitations are compiled and synthesized, resulting in recommendations.

g. Meetings are conducted with all teachers at each of the three schools prior to writing the initial draft. All comments are recorded; many problems are discussed and probable solutions derived.

h. All lessons and activities are carefully reviewed for appropriateness and feasibility (simulated role play).

(1) Each individual taped lesson, student activity, and directed group activity is experienced. The lessons (taped) are listened to twice; once for general approach, a second time for specific directions.

2. INITIAL DRAFT - WRITTEN AND TYPED

a. The first draft is written and typed.

b. The order of the reports generally includes:

(1) Introduction

(2) General recommendations covering broad concerns

(3) Specific recommendations for each lesson and activity following the order of the lessons in the unit.

3. EDITING

a. The first draft is submitted to interested parties for comment and editing.

4. REWRITE - FINAL TYPE

The length of time required to complete the stated process of preparing a unit report has varied according to the length of the unit. An absolute minimum of two weeks for a small unit is required. Some units have required three man months of intense effort.

The remainder of the paper describes in detail the anaylsis of the specific data collected for the Placement Tests.

PROCEEDURES

The Placement Test is an inherent part of Individualized Science. The purpose of the Placement Test is to assess pupil knowledge of the science content in each unit. Lessons in the unit are prescribed according to individual performance on the test.

As one phase of the total formative evaluation of the Individualized Science program, RBS conducted a study during the field testing of the initial units of the program in the 1971-72 school year. For purposes of the study, the Placement Tests were administered on a pre-post basis, thus employed as an evaluation instrument as well as a diagnostic tool of the program. The data were provided by three field test schools representative of rural, urban, and suburban populations.

The purposes of the investigation were (1) to evaluate the quality and effectiveness of each unit Placement Test in Levels A and B (grades 1 and 2) and (2) to establish a performance indicator for the formative evaluation of each individual unit.

DESIGN

An item analysis was performed on the Placement Test results for each unit in order to examine specific items and to ascertain test reliabilities. Tests were necessarily divided into independent items for the analysis. A summary of this analysis is

presented in Table I.

In addition to the item analysis, a pre-post comparison was made as a partial evaluation of transactions. A correlated t-test was used with the results of each test. It should be noted in Table II that the decrease in sample size was attributed to a lack of post test data return from all schools. The numbers reported are from the suburban and urban samples as designated.

In addition to the statistical analysis an informal test format examination and content evaluation by RBS staff and consultants was performed in both the audio-cassette presentation and the paper and pencil answer sheet.

TABLE I

ITEM ANALYSIS SUMMARY

Test	No. of Items	Alpha
Simpson	21	.703 (N=381)
Galileo	25	.842 (N=390)
Michelson	6	.554 (N=366)
Burbank	32	.800 (N=213)
Hooke	13	.850 (N=111)
Curie	27	.613 (N=65)

TABLE II

PRE-POST COMPARISONS

Simpson (N=110)	t = 17.25* (suburban)
Galileo (N=87)	t = 5.46* (urban : N=55) t = 2.48* (suburban : N=32)
Michelson (N=71)	t = 6.40* (urban : N=33) t = 8.21* (suburban : N=38)
Burbank (N=24)	t = 2.71* (suburban)
Hooke (N=12)	t = 6.51* (suburban)
Curie (data unavailable)	

* Significant at the .05 level.

RESULTS

The following general results of the formative evaluation of the Placement Testing within the program were observed:

1. significant differences were noted relative to the correlated t-test between the Placement Test administered as a pretest and the same Placement Test administered as a posttest for each unit investigated (See Table II);
2. item analysis utilizing the initial Placement Test results provided evidence for the revision of specific items of the test;
3. the reliability of the instruments was ascertained providing additional evidence for desirable changes in the test (See Table I);
4. format and audio-tape inconsistencies were discovered relative to the organization and visual presentation of the test items.

It was concluded from these results that certain Placement Test items must be revised, added, and/or deleted; that individual unit lessons must be revised because of the evidence indicating lack of significant achievement; and that format changes must be introduced in order to eliminate confusion resulting from inadequate visual and tape presentations.

The results of the evaluation of the Placement Testing component of the total Individualized Science program are reflective of the total formative evaluation design presently being implemented by Research for Better Schools, Inc.

CONCLUSIONS AND RECOMMENDATIONS

Of the six Placement Tests, Michelson and Curie exhibit questionable reliabilities. It is recommended that the Michelson test be lengthened and that the items and concepts in the Curie test and unit be further examined and revised in order to increse

their reliabilities.

The significant differences observed in each pre-post comparison hold positive signs towards the attainment of the program objectives. The use of control schools in the future will lead to more generalizable conclusions relative to transactions and achievement.

EDUCATIONAL IMPORTANCE

When the development of an instructional system has been completed and its effectiveness demonstrated, its educational implications are considerable.

The RBS study has demonstrated a cooperative professional effort in the evaluation and development of an innovative educational program. It exemplifies the practical and unique relationship and communication which can and should exist between educational research, curriculum development, commercial production, and the "grass roots" practitioner. Such a relationship is invaluable to our goal of quality education and should be spread throughout our educational system.

In addition, the study has exhibited the purpose and importance of formative evaluation in curriculum development. It has shown the direct relationship between objectives and evaluation - that is, evaluation is essentially a process of determining to what extent the objectives specified are being realized by the instructional program.

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APPENDIX A